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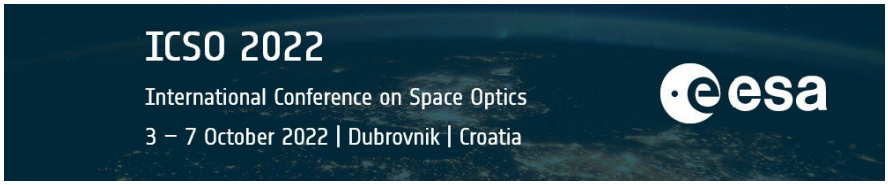

IR and VIS-NIR Light Sources characterization for JUICE

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IR and VIS-NIR Light Sources characterization for JUICE

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ABSTRACT

This paper covers the description and main results of the setup and characterization of IR and VIS-NIR light sources for the MAJIS instrument of the JUICE mission. The setups were a challenge as it involved the need of optical characterization of the emitters in vacuum at very low temperature.
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Keywords: IR sources, VIS-NIR, Low temperature, JUICE, vacuum.

1. INTRODUCTION

The MAJIS instrument is the JUICE mission's imaging spectrometer, covering wavelengths of 0.5 to 5.54 µm. The Optical Head comprises the telescope, the VIS-NIR and IR spectrometers, the FPA detectors and their FPE proximity electronics for each channel. IR and VIS-NIR light emitters are going to be used as references for calibration.

The Infrared Radiation Source JSIR350 series is a fast radiation source for use with thermopiles and pyroelectric detectors in NDIR gas analysis and other applications. It has high intensity and ability to pulse at high frequencies up to 70Hz and it emits across a broadband from 1 to 20µm with a lifetime up to 100,000 hours. These sources use the Intex MEMS IR source element with patented a-CNC films.

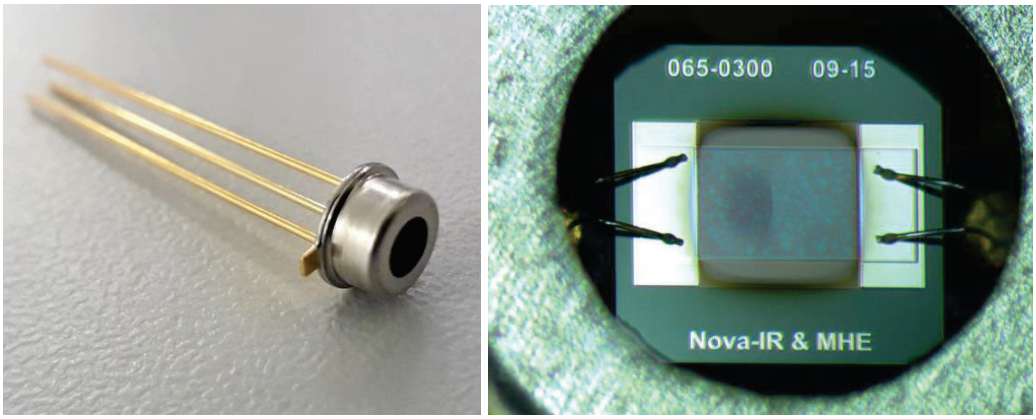

Figure 1. IR Sources Tested

* In ALTER during the testing presented in this paper. Now in Sener

The VIS-NIR emitters are a gas-filled Krypton miniature lamp, with lensed-end envelope. They are driven at 0.5 A maximum current, giving an average luminous flux of 34 lm.

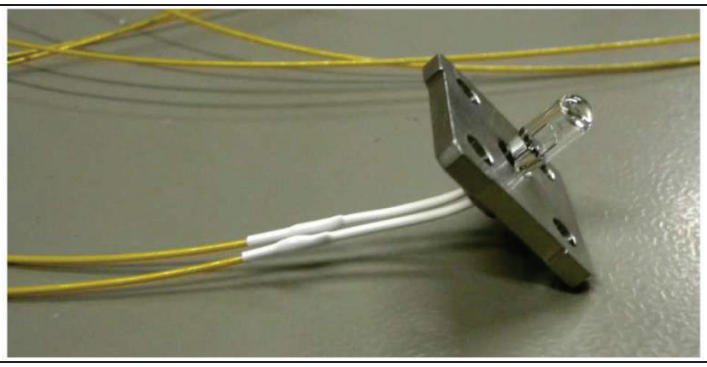

Figure 2. VIS-NIR Sources Tested

The electro-optical characterization of these emitters was a challenge due to the environmental conditions requested: vacuum and temperatures down to -160ºC for the electro-optical characterization and burn-in. A description of the setup used for the optical and electrical characterization of the IR and VIS-NIR emitters will be presented.

2. DESCRIPTION OF THE SETUP

The characterization setup for both types of emitters was based on using a small vacuum chamber with a window to allow coupling the emitted light to a MM fibre (600µm core). This small vacuum chamber is then placed inside a climatic chamber and the MM fibre it taken to a monochromator placed outside the chamber at ambient temperature. The following picture shows a scheme of this setup.

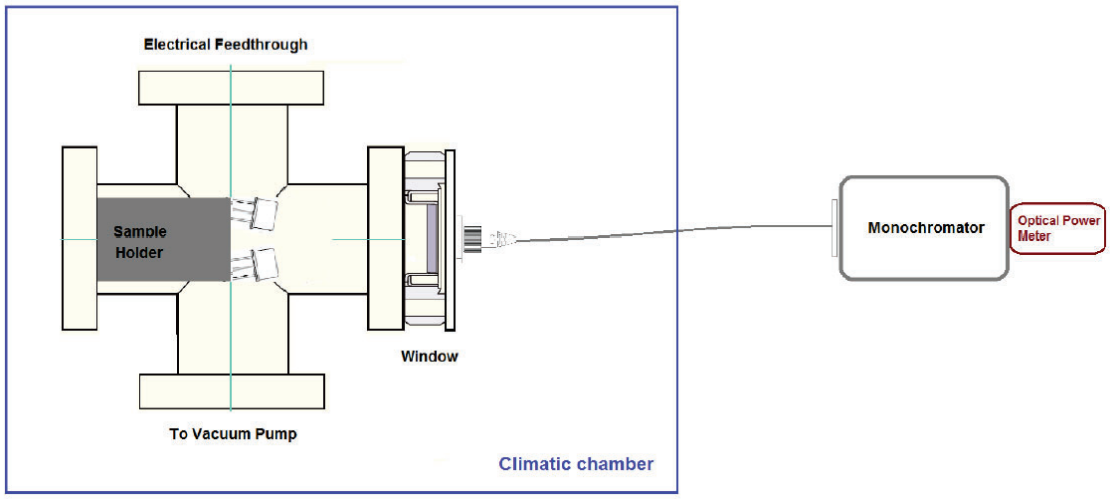

Figure 3. Schematic of the IR and VIS-NIR optical characterization setup

For the electrical characterization, a SMU (Source Measure Unit) was used to supply current to the calibration sources and measure voltage at 4 wires just up to the terminals (wires) of the calibration sources.

2.1 VIS-NIR characterization Setup

For performance test, method based in monochromator and photodiode is used.

Components are placed inside a vacuum chamber. Calibration sources are mounted over a mechanical support, always in the same way, and at the same position. This chamber is equipped with a window which allows light to be measured at the outside of the chamber. Light is guided with an optical fiber to the monochromator. At the output of the monochromator, one photodiode is used to measure current generated by the light of the sources. Photodiode used to carry out measurements is the model G12183-010K by Hamamatsu Photonics.

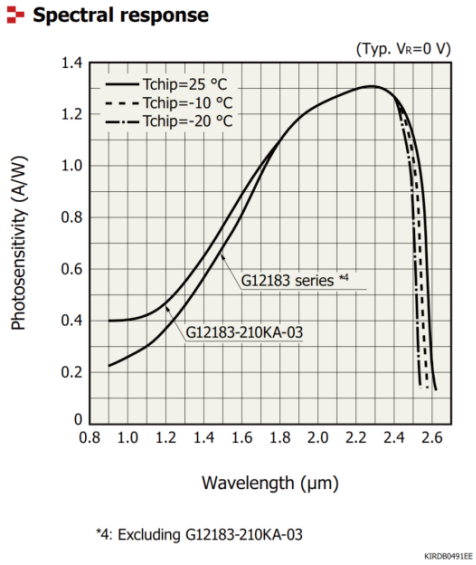

Figure 4. Spectral response of G12183-010K photodiode used for the VIS-NIR characterizations

Next images show setup used for electrical and performance tests:

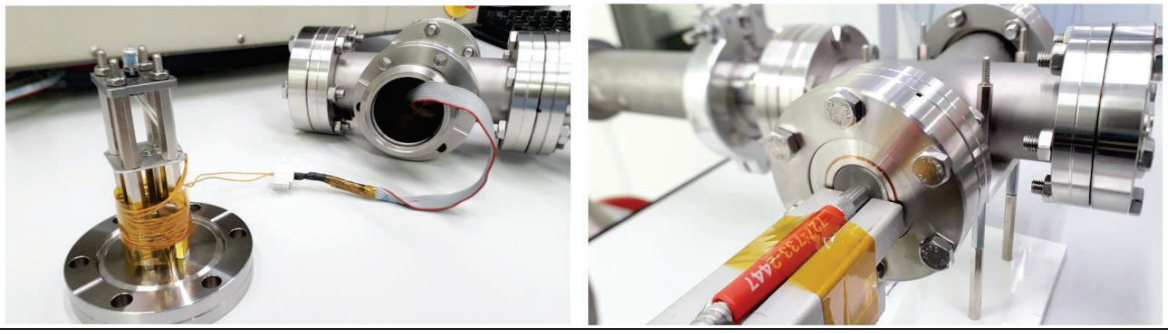

Figure 5. Vacuum chamber and supports used for the VIS-NIR characterizations

2.2 IR sources characterization Setup

For the IR sources a similar test setup was used. The Samples are placed over a metallic support. An optical fiber guides the light emitted by IR sources to a monochromator, which is in charge of separate wavelengths in the range described in test conditions. At the output of the monochromator, one photodiode G12183-010K by Hamamatsu Photonics is responsible to measure response of the IR source at each wavelength. One SMU reads current values generated by the photodiode at each wavelength. A Labview application is responsible of controlling equipments and saving data acquired.

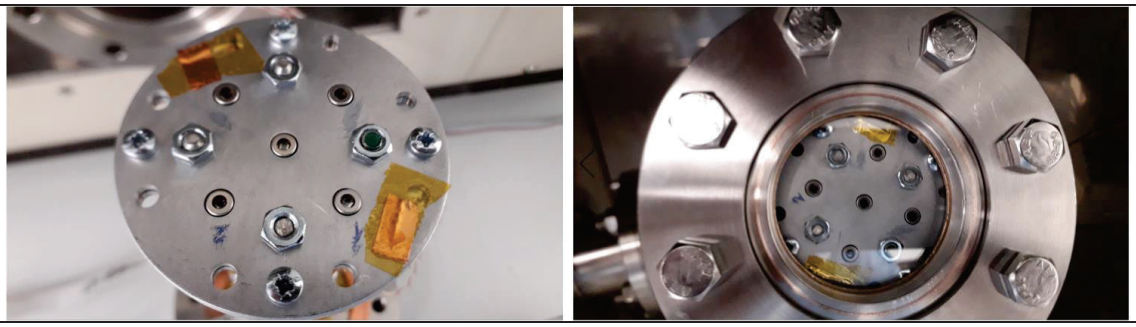

Figure 6. Vacuum chamber and supports used for the IR sources characterizations

The following picture shows the alignment of a single MM fiber for the characterization of the emitters at each position. The maximum was

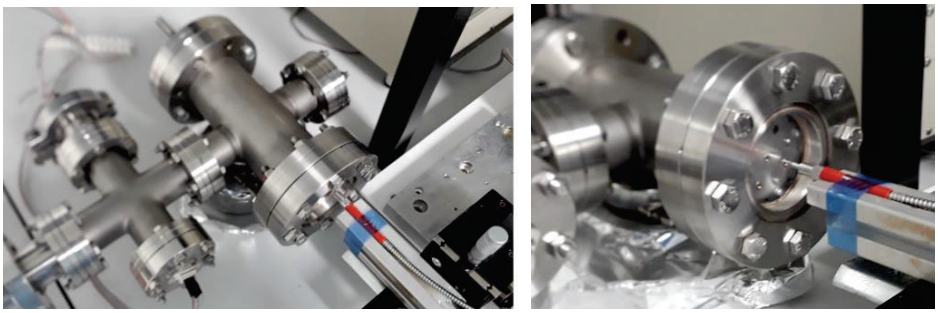

Figure 7. Vacuum chamber and supports used for the IR sources characterizations

2.1 Vacuum Burn-in Setup

The burn-in and a life test of the emitters was done also in vacuum conditions while thermally cycling. The setup for these tests was based on the use of a fibre bundle coupling the light of each emitter to the input of the monochromator. This allowed independent characterization of each emitter at intermediated steps. The following picture shows the setup during the thermal cycles. The small vacuum chamber is placed inside the climatic chamber and the temperature is controlled with a T-type thermocouple place inside the vacuum chamber. A LabView software with a PID control loops allows the adjustment of the temperature inside the vacuum chamber by changing the temperature requested to the climatic chamber. The fibre bundle is coupled to the vacuum chamber inside the climatic chamber and goes out through a hole on the front door.

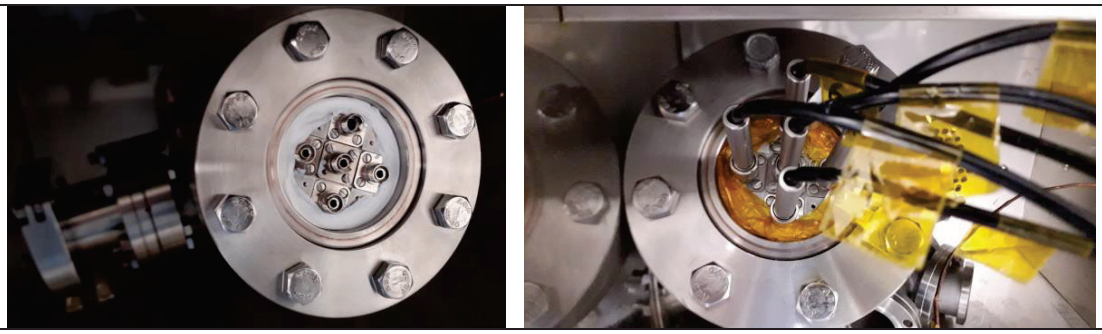

Figure 8. Vacuum chamber with FC connectors to allow the alignment of the MM fibre bundle in front of each emitter.

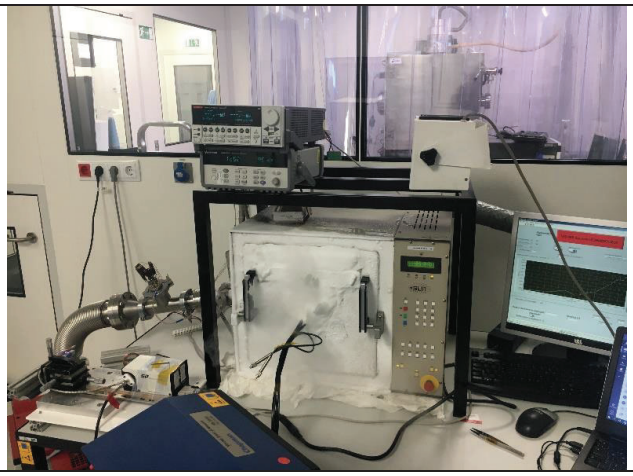

Figure 9. Vacuum chamber with FC connectors to allow the alignment of the MM fibre bundle in front of each emitter.

The following picture shows the vacuum thermal cycling profile applied to the lamps:

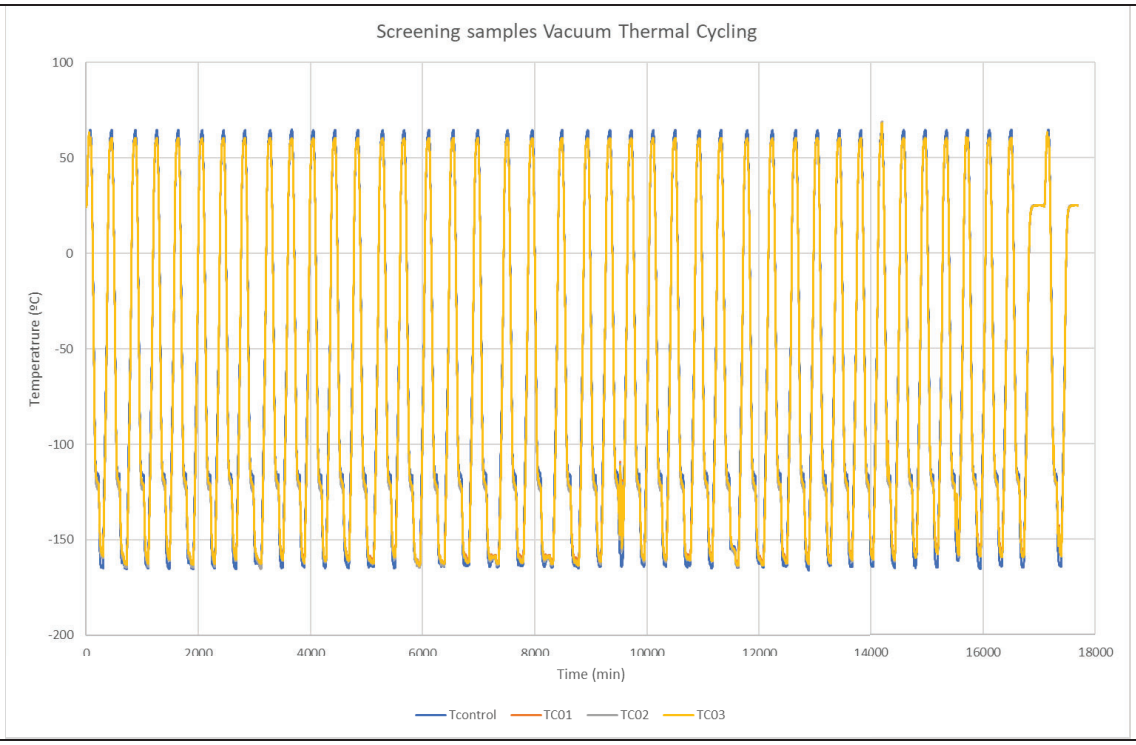

Figure 10. Vacuum cycles applied to the VIS-NIR lamps while powered ON.

3. TEST RESULTS

The following pictures show, as an example of the results obtained, the intermediate steps characterization of one of the lamps at several temperatures at the beginning, after 21 and 42 thermal cycles.

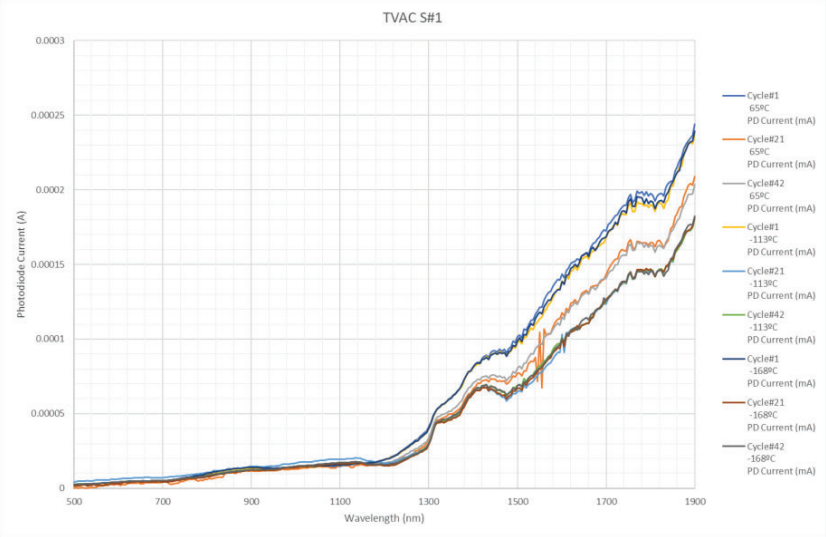

Figure 11. Intermediate optical characterizations of the VIS-NIR lamps during the vacuum thermal cycles.

4. CONCLUSSIONS

A description of the setup for characterization of light sources in the VIS-NIR and IR wavelengths in vacuum at low temperature (-160ºC) has been developed and used to characterize the emitters that will be used in the MAJIS instrument of JUICE. The results proved acceptable degradation of the light sources tested showing additionally that the setup proposed was a good approach for the complex characterizations needed.

REFERENCES

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